An introductory note:

In August 1998, Representatives James Saxton and Curt Weldon requested the National Ocean Research Leadership Council (NORLC) of NOPP to "propose a plan to achieve a truly integrated ocean observing system."

In response to that request, the report "Toward a U.S. Plan for an Integrated, Sustained Ocean Observing System" was prepared by a joint federal/non-federal Task Team co-chaired by Worth Nowlin of Texas A&M University and Tom Malone of the University of Maryland. Quoting from the letter transmitting the report to NOPP's Ocean Research Advisory Panel (ORAP), the authors indicated that the report should be considered an initial effort and that a more fully developed plan would be forthcoming at a later date. The initial plan was considered by the NORLC to be a useful initial effort upon which to build.

The NORLC envisioned this initial report serving as a vehicle to engage the broader community - NORLC member agencies, other levels of government, academia, the private sector, non governmental organizations, and the Congress - to facilitate a community-wide debate concerning how we might best proceed. In so doing, the NORLC recognized that a number of issues would be lively topics for debate: how to manage the overall effort; how to achieve the integration of present and future systems, integrating both within and between the coastal and open ocean elements; how to develop an ocean-wide program with the international community; and how to identify objectives, requirements, and priorities.

The NORLC requested the ORAP, chaired by John Knauss of the University of Rhode Island, to accept responsibility for development of the next step toward a comprehensive plan, building on the initial report and the results of the community-wide debate.

That next step resulted in the following report, "An Integrated Ocean Observing System: A Strategy for Implementing the First Steps of a U.S. Plan." It has been prepared by a working group of experts (the Ocean Observations Task Team) chaired by Robert Frosch of Harvard University and convened under NOPP's ORAP.

An Integrated Ocean Observing System:

A Strategy for Implementing the First Steps of a U.S. Plan

SUMMARY OF RECOMMENDATIONS

A. Management and Organization

1. Use NOPP as the basis for establishing the management and organizational structure required to implement a U.S. Ocean Observing System.

2. Develop appropriate interagency memoranda of agreement necessary to ensure defined agency roles and responsibilities.

3. Establish an Integrated System Program Office (ISPO).

4. Establish a National Ocean Observing System Operations Center (NOOSOC).

5. Initiate development of common criteria for program development and implementation.

6. Designate agencies as appropriate for specific functions, such as for the open ocean, coastal/EEZ, and host for the System Program Office and Operations Center.

7. Establish a multi-sector working group under NOPP involving federal, state and local government, academic and private sector representatives to define necessary reciprocal relationships required to implement and sustain the development and operation of a national ocean observing system.

B. Funding

1. Augment current funding with approximately $30 million of new money starting in the first year, and growing to approximately $100 million annually within three to five years. These funds will be used consistent with an implementation plan to be approved by the National Ocean Research Leadership Council.

2. Funds should be allocated to individual agencies with the purpose clearly identified for NOPP related ocean observing system in accordance with an overall plan to be developed within the NOPP management framework.

3. Examine on-going activities to ensure there are currently no redundancies of effort and to further identify gaps requiring additional funding.

C. Investment Strategy

1. System Design and Engineering Analysis

- Use an end-to-end systems engineering and development approach with a systems integrator to develop a schedule and plan that ranges from concept design to operational implementation.
- Conduct a system engineering analysis to determine how current and planned systems can be more cost-effectively integrated in the near term.

2. Enhancements of existing operational systems

- Fund projects to enhance current operational or research networks that demonstrate an integrated approach to ocean observations or demonstrate a multi-systems approach that is practical and scaleable to larger systems.

3. Concept demonstration projects

- Competitively fund projects to develop regional observing systems at a rate of 2-3 per year for five years each.
- Fund a project to develop an observing system in the U.S. exclusive economic zone (EEZ).
- Coordinate the development of seafloor observing systems through Dynamics of Earth and Ocean Systems (DEOS) by funding the program initiated by NSF and by ensuring its transition to operational capability by making it part of the overall IOOS.

4. Data management, dissemination, and assimilation

- Convene the Standards and Protocols Working Group to develop an overall architecture for the system that incorporates existing data centers and specific standards/protocols for data.
- Implement a national effort to share data from multiple coastal data systems.
- Carry out the U.S. component of the Global Ocean Data Assimilation Experiment (GODAE).

- Fund the development of prototype national data systems based on existing ones and at least one project to develop a regional "test-bed" system that interfaces with existing National Data Centers.

5. New technology

- Develop appropriate techniques for remote sensing and in situ biological measurements and incorporate them into a sustained, distributed infrastructure.
- Develop techniques for making observations of carbon dioxide and chemical and isotopic tracers and incorporate them into a sustained, distributed infrastructure.

D. Policy

1. Review NOPP legislation and make appropriate changes to ensure a balance between research and operations.

2. Encourage the administration to prepare an executive order or presidential decision directive.

3. Develop legislation as appropriate to establish a public-private partnership that provides the framework for private sector, and state and local government participation and contributions to the system.

4. Develop a management policy, open system architecture and standards and protocols for inclusion in the system.

E. Next Steps

1. Initiate actions as soon as possible under the auspices of the National Ocean Research Leadership Council of NOPP to begin the process of implementation.

2. Initiate outreach activities with state and local governments, academia, non-governmental organizations, and industry to solicit support, involvement and contributions for system design and governance.

3. Work with existing international organizations to establish connectivity with appropriate international observing systems.

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An Integrated Ocean Observing System: A Strategy for Implementing the First Steps of a U.S. Plan

PREFACE

The ocean is central to the health, economy, and national security of the United States. Examples of remarkable returns on investment in ocean observing and predicting have been El Nino forecasts, improved hurricane landfall predictions, prior knowledge of harmful algal blooms, improved information for the fishing industry, and enhanced safety at sea for all sectors of marine recreation and transportation.

These advances in the use of ocean knowledge have been built on decades of investment and effort by academia, industry, and government (local, state, and federal). However, more detailed and difficult questions of the ocean remain to be answered. Examples include the role of the ocean in regional and global climate change, hypoxia and loop currents in the Gulf of Mexico, plankton declines off California, Gulf Stream movements off the southeast U. S., sea level rise in low-

lying areas, variability of fish stocks off the Pacific Northwest and New England, ice movement in the Great Lakes, and naval operations in complex coastal environments.

Addressing these new questions requires innovative means for governments, industry and academia to work together; new approaches to investment in knowledge and assuring return on those investments; and new mechanisms to transfer technological advances into operational ocean observing systems. All of these - partnerships in governance, changing intellectual investments, and technology transition - are needed to realize the application of ocean knowledge in the future. The relative cost of taking a new approach to this application of ocean knowledge is low, the impacts are high, and the benefits to the nation are great.

PURPOSE OF THIS PLAN

This report recommends actions (see Recommendations - Action Plan) to implement a U.S. Plan for an Integrated, Sustained Ocean Observing System, submitted to the Congress in April 1999. Secretary of the Navy Richard Danzig and Under Secretary of Commerce for Oceans and Atmosphere D. James Baker requested the Ocean Research Advisory Panel (ORAP) of the National Oceanographic Partnership Program (NOPP) to "accept the responsibility for development of the next step toward a comprehensive plan." This report is the response to that request to ORAP. It should be viewed as the next step in implementing a U.S. Plan for an Integrated, Sustained Ocean Observing System. The Task Team was convened by ORAP to develop a general plan, not to determine the details of agency programs and budgets. The intention was to focus on the next steps and how best to proceed.

Various national and international reports and proposals have addressed the need for an integrated approach to ocean observations. This report will not repeat the analyses and cost-benefit evaluations of existing observing systems that these reports contain. Rather, it builds on the previous documents, a list of which is included in the Bibliography.

VISION AND OPPORTUNITIES

A comprehensive, integrated national ocean observations program will, for the first time, bring together federal, academic, state institutions, and industry into a coordinated system for monitoring U.S. marine waters. Although there are some coordinated national and international research programs in ocean observations (e.g. the World Ocean Circulation Experiment [WOCE], the Tropical Ocean Global Atmosphere [TOGA] program, the Joint Global Ocean Flux Study

[JGOFS], and RIDGE [Ridge Inter- Disciplinary Global Experiments]), there is ***NO COMPREHENSIVE NATIONAL OCEAN OBSERVATIONS PROGRAM FOR THE LONG TERM AND AIMED AT SUPPORT OF APPLICATIONS.*** A coordinated national approach, linked effectively with similar programs in other nations, is an essential prerequisite for effective use and management of the oceans. The nation cannot realize the economic, social and security benefits of the oceans in a responsible, sustainable manner without such a program. These considerations led to the request by Congressmen Jim Saxton and Curt Weldon in 1998 to the National Ocean Research Leadership Council (NORLC) of NOPP to "propose a plan to achieve a truly integrated ocean observing system." The recently released report to the President, "Turning to the Sea: America's Ocean Future" also identifies the need for such a plan.

Recent programs, including those mentioned above, have established key elements of the foundation upon which the IOOS can be built - new technologies, intensive sampling in selected areas of the ocean, and experience in coordinating in situ and remotely-sensed data. By capitalizing on the research efforts and operational activities of various federal, academic, state and private sector organizations it is now possible to undertake a series of actions toward an Integrated Ocean Observing System. The vision is to:

> **Provide a sustained national system for observations of the ocean with outputs that are easily accessible for creating forecasts and products essential to the nation's economy, the management of marine resources, public health and safety, and national security.**

A commitment to this vision implies a new way of approaching and managing operational oceanography, building on a funding and management process that started a few years ago with the National Oceanographic Partnership Program. It is a process in which the whole will be greater than the sum of the parts under a sustained national commitment to a common purpose. This effort will involve multiple sectors and partnerships while focusing on integration of observing systems, data access and information management activities, program management and funding. All of this presents a challenge but the benefits of success outweigh the risk of not moving forward and continuing with the current piecemeal approach to ocean observations.

Over 35 years ago the World Meteorological Organization (WMO) and the United Nations recognized that a coordinated approach to meteorological observations would lead to improved worldwide weather forecasting and therefore began to establish the World Weather Watch (WWW). Since that time the WWW has been

one of the great success stories of international collaboration in global observations and communications. The WWW is essentially a coordinated aggregation of meteorological facilities and observations controlled by the member nations of the WMO. The WWW concentration on coordinating observations, communications, and data access to all participants has had an overwhelmingly positive impact on short- and medium-range weather forecasting and on meteorological research.

In addition to serving national needs, the IOOS would establish the U.S. Component of a global array of observations. An international system will evolve from the interconnection of national systems into a coordinated international network, as conceived by the Global Ocean Observing System (GOOS).

BENEFITS AND TIMELINESS

The Integrated Ocean Observing System will address the observation portion of a larger ocean observation and prediction system that will be based on research and long-term monitoring aimed at specific needs. These needs, as identified in the first report (NORLC 1999), are:

- detecting and predicting climate variability
- facilitating safe and efficient marine operations
- ensuring national security
- managing living resources
- preserving and restoring healthy marine ecosystems
- mitigating natural hazards
- ensuring public health

Recent technological developments have significantly improved ocean-observing systems. Satellites, drifting and fixed buoys, cables, autonomous vehicles and state-of-the-art ships each collect a variety of oceanographic data, but these observations are not comprehensive enough. Important gaps exist in coastal, open-ocean, and seafloor data sets, which are poorly integrated. By improving the coordination of data collection, storage formats, and dissemination processes, an integrated ocean observing system would provide more complete real-time information on global ocean and coastal conditions for a full range of users. The economic benefits are large and real in terms of cost savings and mitigation of problems, as well as economic investment and return.

While it is difficult to estimate precisely the economic benefit, various analyses (EuroGOOS 1996, UNESCO 1998) indicate that improved information about the ocean is likely to result in savings of at least several billion dollars annually against the required investment. As in the case of weather and climate services, strong public-private partnerships will result, such that U.S. industry will have the opportunity for growth; government at all levels will be able to better serve the public; and the public will benefit by having access to new products and services. The industries and government services that will benefit are wide-ranging and include, among many, offshore oil and gas production, recreational and commercial fisheries, agriculture, coastal tourism, recreational boating and commercial shipping, coastal engineering, weather forecasting, habitat restoration, naval operations, and search and rescue.

By building on existing activities, capabilities, and infrastructure, and by using a phased implementation approach, work can start immediately to achieve the vision. New technologies, past investments, evolving scientific understanding, advances in communications and data processing, and pressing national needs all combine to allow initiation of an Integrated Ocean Observing System. We know what to do and we can begin immediately. The major piece missing is the framework and the money necessary for integration towards a common national purpose. If we can provide that framework, the result in ten years will be a system for observing the ocean that will also facilitate access to ocean data, assuring a broad spectrum of routine products and services from a system rich in data and information.

SYSTEM STRUCTURE

The architecture of the overall system will be determined by 1) the means of integration of existing and new programs and data, 2) the functions to be performed, and 3) the technical framework as modified by considerations of feasibility and cost-effectiveness.

Integration

The governance and management of the system will be designed, funded, and implemented to bring new programs on line while making the most of existing programs. Government, academia, and industry will be encouraged to work together to integrate the system into a functioning whole. Only with such a strategy will the system be able to operate effectively to meet the needs of all users.

Integration will take place in several ways and will include existing systems, future system components, definition of requirements, communications, data and information management, and program management and organization. There are

two fundamental levels at which integration must be achieved 1) the data level, resulting in the design of an easily accessible, open-system infrastructure that will permit common usage of data and data products across scientific disciplines and geographical areas for varying purposes, and 2) the governance level, resulting in the development of common criteria for program development and implementation (perhaps codified in an Integrated Operations Requirements Document) that will be agreed to by the funding organizations that will be the source for establishing system baselines, structure, and cost estimates.

An agreement on a core set of variables to be measured is another step toward integration. Table (1) presents an internationally-recognized set of core variables routinely used by national programs, by the operational Navy for national security, by industry, and by state, federal, and academic institutions. This is not a list of all possible parameters but is only a starting point. These are the significant observations that will be at the core of the IOOS.

Key functions

The system, with its related management and technical infrastructure, must:

- Identify existing or planned observation, data management and communication systems that can be integrated;
- Identify key deficiencies in global and coastal observations based on both national and international programs and user requirements, and develop a balanced programmatic approach to these that accommodates the differences between national and international waters;
- Establish and maintain an integrated set of programmatic and technical requirements for all elements of the system;
- Facilitate the development of better operational products by integrating multiple data sets, nationally and internationally;
- Ensure that the capabilities of the providers of data and data products are matched to the needs of the users;
- Provide a data and information system with an architecture that ensures full and open real-time (or near-real-time) access for operational applications and is able to accommodate historical data sets;
- Provide sets of metadata that fully document the observing system and the operating procedures under which the data were collected;

- Provide research and development to improve the system and a mechanism to transition new technologies from research to operations.

Framework

The three key components of the national ocean observing system that are critical to its success are the observational subsystems, the communications network, and the data management subsystem. Some of these building blocks already exist or are planned, but the complete system architecture, the network for providing access among the data-providers and users, and the system for managing the data generated in both real-time and delayed-mode have yet to be developed. The final structure will result from a phased implementation approach starting with integration of major existing systems and networks in all three components. Descriptions of existing and planned activities are provided in various reports and will not be repeated here. However, the essential technical elements of a national system will include:

Observations:

- A distributed global system and the U.S. portion of the international open ocean system that includes satellites, dedicated ships and aircraft, ships and aircraft of opportunity, buoys, profiling floats, advanced in situ sensors, fixed arrays, and other elements as appropriate.

- A system designed to collect observations from subsystems based on political jurisdictions (see Investment Strategy for further details) in which the U.S. has interest and responsibility.

Communications:

- A network for the system that links together various networks to form a "network of networks" or "hub-node" system that is centrally managed so that, as part of its operating procedures, it manages the development standards and protocols as well as the overall communication system operations and provides information on data quality. This network will form the "backbone" for the entire observational system linking together data providers and users, observations subsystems, centers of data, and data archives.

Data Management:

- A distributed network or federation of data and information management centers organized for processing and distributing observational data in real-

or near-real-time, as well as delayed-mode (including material samples) shore processing facilities, all of which will enhance existing national and regional capabilities.

- A management system that builds on existing facilities and is responsible for the long-term cataloguing, maintenance and storage of data and metadata, final quality assurance, and data rescue and migration (transfer of data from one storage medium to another as technology advances). This will include a data archive system (partly or wholly centralized) to ensure archival preservation and backup.

Crosscutting Elements:

These are issues of critical importance to the system that are applicable to all three system components described above.

- A technology, products and applications program that ensures development of appropriate new technologies and products (through direct or indirect means). This program will be interactive among technical designers, researchers and operational users.
- A research program that makes available the results of long-term observations to improve understanding of ocean processes, provides the foundation for further advances in technology, and demonstrates the practical utility of the system.
- An education and outreach program that makes the data available to the public, schools, and media in real- or near-real-time for teaching and public awareness.

Although the processes in the oceans are seamless, political boundaries exist that make it practical, for program management purposes, to divide the system into the deep, open waters that are under international jurisdiction, nearshore waters whose boundaries correspond to the U.S. exclusive economic zone (the EEZ, between three and two hundred geographical miles offshore) under federal jurisdiction, and coastal waters and semi-enclosed seas (bays, estuaries) whose waters are managed by state and local governments. The Great Lakes are also considered a part of this system but are a special case since they are enclosed yet have multiple jurisdictions. The specific issues with respect to investment in these areas will be discussed in the Investment Strategy of this report but the overall system will take care to strike a balance among observations made in all three areas.

The complete ocean observing system will evolve as a result of interaction among three different groups. One group consists of the users who will define the needs for specific observations within the context of the overall goals of the system. The users may range from scientists to academic and commercial developers of data products to farmers and fishermen. The second group consists of the technical experts who design and run the systems for collecting observations of the ocean. They respond to the users by developing a system that can meet their needs. The third group is the researchers that provide knowledge to bridge gaps between the user needs and the capabilities of the data collections systems. It must be noted that researchers in this context develop technology and applications in support of the ocean observing system. Researchers whose work is enabled by data from the system form one of the user constituencies, although individual researchers may participate in both kinds of research activity.

INVESTMENT STRATEGY - FIRST STEPS

An organized long-term investment strategy is required to enable the system to evolve as new technologies are developed and old ones changed, and as measurements are added. While integration of existing activities alone would provide a real gain, it is only the investment in program enhancements and new efforts that will permit significant progress, with concomitant gains in benefits.

The initial system will consist primarily of sustained measurements of physical variables, such as temperature and currents (see **Table 1** for a more complete list), since they are the fundamental driving forces in this fluid environment, and because the technology already exists to measure these variables in real time at the appropriate scales. The system that exists in ten years, however, will also include measurements of the critical chemical, geophysical, and biological variables. All measurements will be taken in four dimensions (three in space plus time) at appropriate scales (that could range from meters to hundreds of kilometers and from minutes to decades) in order to provide the ocean characterization necessary to meet the operational needs of users. At this time, the scale(s) of measurement for many of the non-physical parameters necessary to meet the user needs are not known and so the dimensions as well as the means of taking those measurements will have to be developed. The best technologies for measuring variables at the required scales will include those taken by a variety of sensors (e.g. mechanical, optical, acoustical, geophysical, chemical) from a variety of platforms (e.g. in situ buoys and drifters, cables, ships, aircraft, satellites, telemetered tags on organisms). The system will utilize the best technology or technologies to ensure the best data are taken to meet user needs under constraints of affordability and robustness.

The investment strategy adopted for this ocean observing system will be comprised of advances in the following five categories. Each category will be discussed separately.

- System Design and Engineering Analysis
- Enhancement of Existing Operational Systems
- Concept Demonstration Projects
- Data Management, Dissemination, and Assimilation
- New Technology

System Design and Engineering Analysis

The key to a successful system will be an adequate design, based on input from the users, the researchers, and the operators, that will assess the cost-effective engineering trade-offs, monitor the efficiency, and provide the technology roadmaps for the entire system. The system must be capable of facilitating the connections between the research and operational parts of the entire system, enabling smooth, effective transitions of technology. In order to integrate the various existing and planned ocean observations and provide for the future adaptability of the system, **it will be necessary first to prepare an engineering and design analysis that will address all of those issues.** This can be done through the establishment of an organization or committee within the overall governance structure dedicated to this ongoing analysis. This working group will collaborate with counterparts by providing user input, designing the data management and communications subsystems, and developing system standards and protocols.

Enhancements of Existing Operational Systems

The development of an overall design that is based on engineering as well as scientific concerns is an important first step towards achieving the fully integrated system. However, the existing observing efforts that will eventually be incorporated into the full system will continue to provide data; **improvements to existing observing programs that can be accomplished now should move forward without waiting for the full design and engineering analysis.** The complete list of existing observation efforts in the federal agencies can be found in the report by NORLC (Appendix 1, pp. 47-61) and will not be reproduced in this document. Expansion in space and time of moored, cabled, and drifting arrays, opportunities for increased shipboard monitoring and satellite coverage, and

incorporation of improved technology should proceed. In addition, changes or enhancements to existing programs that eliminate redundancy or improve the efficiency of those efforts should also be allowed to move forward. These short-term investments will ultimately result in a better overall system.

Concept Demonstration Projects

These relatively limited, small-scale efforts, also known as pilot or pre-operational projects, are critical for the evolution of the system. These projects might involve a demonstration that a new technology can be successfully used in an operational fashion, that an existing data collection effort can be scaled up in time or space, or that several smaller efforts can be successfully integrated into a larger program on a regional or basin scale.

The third example above - smaller efforts integrated into a regional program - will be a key element during the initial phases of the integrated observing system. There already exist a variety of observing efforts, many of which are co-located in specific areas. Examples of these include (but are not limited to) 1) in the open ocean, the Tropical Atmosphere Ocean (TAO) array), the Array for Real-time Geostrophic Oceanography (Argo) and acoustic tomography; 2) in coastal waters, the California Cooperative Oceanic Fisheries Investigations (CalCOFI) Program, the Georgia Towers, the Santa Barbara Channel-Santa Maria Basin Circulation Study, the Tampa Bay PORTS-West Florida Coastal Ocean Monitoring Program, the Long-term Environmental Observatory (LEO-15) in the New York Bight; and 3) in semi-enclosed bays and estuaries, the Chesapeake Bay Observing System, the Great Lakes Forecasting System, the 28 National Estuary Programs, and the 25 National Estuarine Research Reserves. None of these existing efforts meet the definitions of this report for being both integrated and sustained over a large region (regions as defined earlier). However, **many of these existing observation programs could form the nucleus of demonstration projects for regional-scale integrated observing systems.**

As part of the initial investment strategy, concept demonstration projects can establish the basic regional pieces of the nearshore and semi-enclosed seas component of the IOOS. The concept is that there would be federal funding awarded competitively to collaborative proposals to scale up existing efforts into regional components of the national IOOS. The regions are envisioned to be the Northeast, the Southeast (including the Gulf of Mexico), the West Coast, the Great Lakes, Hawaii, and Alaska. The initial projects would be competitive among regions but as the concept demonstration projects transition into operational systems that are largely funded by regional entities, the federal part of the program

would fund additional programs in order to fill in the regional gaps. Some level of federal funding would always supplement these regional pieces of the system (probably for maintaining the observations of the core set of variables) providing they meet the standards established for the whole system, but the jurisdiction and responsibility for these subcomponents will always remain local. **By 2006, systems should be initiated in all six regions; by FY 2010, systems should be established and functioning operationally in the regions in connection to the larger national system.**

An additional project for the initial phase of the system will be the development of a federally-sponsored observation effort in the EEZ. Since this area is clearly a national responsibility and is largely beyond the capability of most local and state governments to monitor in a sustained fashion, it is reasonable for the federal government to make a substantial contribution to the overall system by covering this region. The concept is a network of measurements taken in this region at a scale appropriate to the overall needs on a national basis. Specific regional needs that require data taken at finer scales would be supported by those regions as a supplement to the basic federal measurement program. This new effort will be started as a demonstration project but is anticipated to scale up to a nation-wide effort quickly, if successful. **In 2002-2006, this system should be initiated at multiple locations around the country; by 2010, this system should be operating throughout the U.S. EEZ on a broad scale.**

Another program that has been in development for a number of years and has reached the demonstration phase under the auspices of NSF is the Dynamics of Earth and Ocean Systems (DEOS) program. Evolving scientific methods, emerging technological capabilities, and the need for observing transient phenomena have set the stage for a new intellectual approach in oceanography. Adaptive "observatory" science will allow the study of multiple, interrelated properties, variables, and processes over a wide range of time scales. The network being developed by NSF is envisioned to include arrays of meteorological, acoustic, physical, biological and chemical sensors at the ocean surface and midwaters of the ocean as well as geophysical sensors on and under the seabed; all of these measurements will contribute substantially to the Integrated Ocean Observing System. **DEOS is largely conceived of as a tool to support research, however, so additional investment from the IOOS will be required to bring this system into the larger one that will serve operational oceanography needs.** Nevertheless, a primary goal of the program is high volume, real-time telemetry of the data from remote locations. The availability in real time of weather, sea surface temperature, bottom pressure (tsunami), vertical hydrophones arrays, and ocean depth accurate to a centimeter can make meaningful contributions to operational needs.

Data Management, Dissemination and Assimilation

A national infrastructure does not currently exist that includes data and subsystems with all of the characteristics described in the Framework section of this document. **The two most important features that must be developed are 1) the distributed network of data and data archives, and 2) the development of standards and protocols for the data.**

It is likely that the data collected by the system will be physically located on a network distributed throughout the country that will be accessible from anywhere. The long-term maintenance and storage of the information generated by the sustained system will require the establishment of a data archive (or archives) that will build on existing archival systems. The needs for the archive(s) will include space, computing power, and staff to process and maintain all of the data that will be sent there for storage, as well as to respond to requests from the observing and user communities to retrieve these historical data sets.

Effective data management can be achieved only with the development and application of standards that are agreed to and followed rigorously by the collectors of the observations data so that the products developed from the data for the users are reliable. The criteria for real-time or near-real-time data may be different from those used to calibrate and validate the delayed-mode data so standards for both types of data will be needed.

As stated in the report by NORLC (pp. 16-17), there are two standard interface formats (the digital arrangement of the information) and one metadata format (the "who-what-when-where-why-how" information accompanying data in order to render it useful) that must be defined in order for the data and communication system to be effective. The exchange formats are those that take data from existing data systems and put them into usable formats for application purposes. An example of this is the distributed oceanographic data system (DODS) of the University of Rhode Island. The product formats are those that allow data from existing application centers to be combined or overlain and jointly displayed. Examples of this are existing geographical information systems. Formats for metadata include prototypes provided by the Federal Geographic Data Committee (FGDC) and used in the Master Environmental Library of the Department of Defense. The development of the standards and protocols for this system should be carried out by an organization or committee that is well acquainted with the above formats. Such standards would be tested in conjunction with the concept demonstration projects that will be established as part of the phasing in of the national system.

Compilation, quality assurance, and dissemination will be the primary tasks of the data management system of the IOOS. Assimilation of the data for use in developing operational products such as predictive models will be an important step beyond the IOOS. In order to facilitate this process, the observing system network should work closely with ongoing and future data assimilation efforts. One example of such an effort is the Global Ocean Data Assimilation Experiment (GODAE).

New Technology

Although the first steps to achieving the overall national observing system will largely involve the integration and extension of existing programs into the operational arena, the system will need to quickly integrate new capabilities. As an example, the measurement of biological, geophysical, and chemical parameters will require new sensors and extensive ship resources. If these needs are filled, the national system will be better able to collect synoptic observations from distributed observing platforms and achieve a multidisciplinary characterization of the ocean environment to serve many purposes. **In order to attain these goals, at least 10% of the overall budget for the system should be dedicated to research and development in these areas. This should be a constant level of support, not a one-time cost to the system.**

The five areas described above represent the broad categories of investment for the integrated ocean observing system. Detailed recommendations in each area are contained in the Recommendations - Action Plan section of this document.

While the discussions above focus on the initial investments, the long-term investments should be addressed by the development of an overall system program plan that defines the tasks and milestones necessary to a sustained ocean observing system. It is important to document the present infrastructure; develop an approved set of requirements to be addressed in a realistic, time-phased, affordable manner; develop long-range cost estimates with a funding plan; and establish the appropriate organizational, user adviser, technology transition, and operations management plans with the necessary documentation and agreements.

MANAGEMENT

The governance and consequent organizational structure that is established for the IOOS must be flexible, but also provide an umbrella for integration which addresses a variety of purposes. At the same time, individual organizations have missions and functions that must be met.

The National Oceanographic Partnership Program

The National Oceanographic Partnership Program was established in 1997, in part to address the need to ensure optimal use of the oceans and coastal areas, and that the U.S. should maintain "its world leadership in oceanography as one key to its competitive future." The existing NOPP structure provides a mechanism to make recommendations to the NORLC on overall program management and implementation. The legislation establishing NOPP and the NOPP structure are included at the end of this document.

Since its inception NOPP has been making progress in meeting its intended purpose. Nonetheless, it is essential to further strengthen the interagency coordination that has been stimulated by NOPP under the auspices of the NORLC. NOPP also provides a mechanism to augment ongoing activities, define an overall investment strategy, and to immediately commence key initiatives. **Consequently, NOPP with its current infrastructure should undertake the task of implementing at least the near-term investment strategy**. It should be emphasized that the management and organization that is necessary for the IOOS is not "business as usual." It represents a new approach, consistent with the intent of NOPP.

While the funding approach should emphasize national implementation as a high priority, U.S. interests also include active participation in various international programs, such as the Global Ocean Observing System, the Ocean Drilling Program, and the Global Climate Observing System. International involvement, therefore, also requires a management framework for coordinating funding commitments, technology development, and implementation. Although NOPP has not been designed specifically for international programs, its structure could easily accommodate this additional responsibility.

Organization

The IOOS should be structured to enhance the missions and functions of the participating federal and state agencies, the private sector, and academia. It is not necessary to make a decision on the final organization immediately. As the overall effort matures and as the results and benefits from the initial investment are realized, the organizational structure should be reviewed and refined. Nonetheless, it is important to have a long-term view of an appropriate structure.

An organizational approach that would provide the benefits of interagency and multi-sector integration is shown in **Figure 1**. It builds on the NOPP framework as a starting point and is modeled after the National Ice Center, a similar cooperative

effort sponsored by the Navy, NOAA and the U.S. Coast Guard. An executive committee (NORLC), advisory committee (ORAP), and interagency and appropriate technical working groups (IWG) should be used to formally coordinate agency planning, funding, program development, and execution. An interagency program office will be required to manage and support the overall process (ISPO-Interagency System Program Office). **A formal memorandum of agreement (MOA) should be signed among the participating agencies, that specifies membership, functions, actions, and agency roles and responsibilities**. Agencies should be identified for specific functions and applications, such as operational communications support, data and information management, deep ocean, coastal, facilities, etc.

To ensure that there is accessibility to the system network and that there is an organization in charge, **a National Ocean Observing System Operations Center (NOOSOC) should be established**. This will be a hybrid organization consisting of both centralized and decentralized components. The NOOSOC would be comprised of an interagency staff with a lead agency designated to host and organize the "Operations Center." The staff could be augmented by visiting scientists and engineers from industry, academia, federal and state laboratories, and post doctorate fellows.

The Operations Center would have a number of centralized functions to provide overall coordination and management direction (hub). In addition, specific responsibilities would reside at specified centers of excellence (nodes), that are either region-, discipline- or function-oriented. These decentralized nodes would have responsibility for specified observations and/or data management and related applications. Consequently, the Operations Center would also be a "virtual center" serving as a clearinghouse to link providers and users of data and information, as well as having the responsibility for maintaining the essential functions of the system. This approach naturally lends itself well to operating a communications and data and information management system, where government and academic data collections would be linked, with NOAA, for example, taking the lead through its national data centers. The hub-node approach lends itself to technology and applications development as well, since the nodes will consist of collaborative efforts that can transition the results of their research into the system via the hub (as one pathway; details on tech transfer below). The NOOSOC would not be a center that is responsible for products derived from the observations, such as predictive models however. These products will come from other entities that will make use of the data compiled and processed by the Operations Center.

Essential functions of the NOOSOC will include:

1) managing the data communication system;
2) implementing policies for standards, protocols, quality assurance, data access, and network operations;
3) serving as a clearinghouse for users and providers of data;
4) serving as a "help desk" to resolve problems and coordinate the system;
5) interfacing with national, regional, and international users and systems;
6) creating unique products not produced elsewhere;
7) allocating funds for research and development to solve common system problems; and
8) allocating funds for required, long-term observations

An organization of this type should develop a clear transition path from basic research to full operations and sustained maintenance. At the heart of this is a strategic planning process that would involve setting measurement requirements for the system based on evolving user needs, evaluating research and technical developments for potential improvements, and examining revised sampling trade-offs. A tactical response will be needed to respond quickly and thoughtfully to rectify performance shortcomings or to capitalize on new instrumental capabilities. These functions must be supported as a fundamental part of the observing system and carried out relentlessly.

Priorities must be set to determine when and how to add elements to the system based on user needs and proven readiness. There is a natural, generic sequence of events leading to the inclusion of a specific element into the integrated national ocean observing system. A generic sequence in time order is outlined below and in **Table 2**:

1. Development of an observational/analysis technique within the research and/or operational communities
2. Community acceptance of the methodology gained through pilot projects demonstrating the utility of the methods and data
3. Pre-operational use of the methods and data by researchers. Application groups, and other end users, with particular emphasis on ensuring compatibility with legacy systems
4. Incorporation of the methods and data into an operational framework for sustained use in support of societal objectives.

Governance

The overall structure of a national approach to ocean observations is that of a

federation involving numerous federal, state, local, academic, industry, private, and international participants. Consequently, an appropriate management structure is required for this federation of operators. Various international organizations already exist that have developed planning documents for global scale ocean measurements. However, the U.S. has not yet developed a consistent, coordinated approach to interfacing with these organizations that has resulted in a long-term, consistently-funded program. One highly successful management model is the Ocean Drilling Program funded by the National Science Foundation and international partners from Europe and the Pacific Rim. Key elements of this approach include a lead organization (not necessarily a federal agency) representing U.S. interests, Memoranda of Agreement (MOA) between the lead U.S. government agency and the responsible funding agency in partner nations, a council representing all the partners, and an international scientific advisory panel.

The governance of a regionalized U.S. coastal ocean observing system must involve the various regional participants. The planning process employed by the Regional Marine Research Program in the early 1990s provides an example for initiating the design of a nationally coordinated program of regional observing systems. Public Law 101-595, November 16, 1990, established regional research programs under federal oversight, and further established Regional Marine Research Boards in each of nine regions and a mechanism for interfacing with the federal government.

The overall management structure should involve lead agencies for the open ocean and coastal components of the observing system, but also a national coordination committee to provide oversight for the entire program. Once again, NOPP appears to have the structure that could be the integrating management vehicle.

The NOOSOC should have a board of directors as part of the Interagency System Program Office to provide overall guidance and direction. The NOPP infrastructure has the flexibility to provide such a board and program office, either through the NORLC or the Interagency Working Group. The Operations Center will also need to be able to work with non-U.S. partners to ensure integration and compatibility with international systems. An implementation plan will be necessary to define the specific centralized functions of the Operations Center, the management and staffing structure, and the roles and responsibilities of the participating agencies and "nodes."

In order to carry out the work necessary to develop and implement the technical aspects of this entire system, it will be necessary to set up a number of standing working groups responsible for defining the technical needs of the system and

providing advice to the ISPO and NOOSOC. All of these working groups have been mentioned earlier in the document in conjunction with different parts of the system and will focus on technical aspects. These working groups are listed below.

- *Users working group* - this will consist of representatives of the various communities that are expected to use the data or data products from the system. Examples of members include the research and technology groups that support the system, ocean process modelers, scientists, resource managers, and operational government agencies.

- *System design and engineering analysis working group* - this will consist of technical experts who will first analyze the existing data collection systems and provide recommendations for integration and will in the future serve to assist in the transition of research products to the operational system.

- *Data management working group* - this will consist of experts in data storage, archiving, and retrieval who will develop the overall system for managing the data from the national system in conjunction with existing data systems, and will in the future provide continuing advice to the governing body of the system.

- *Standards and protocols working group* - this will consist of individuals who will develop protocols for data collection and standards for data and metadata communications and management. This group will operate in collaboration with all of the other advisory groups in order to develop accurate and reasonable standards for the system.

POLICY FRAMEWORK

The National Oceanographic Partnership Program provides an excellent statutory and management framework to get the IOOS started. NOPP is mandated under federal legislation and is comprised of all the federal partners necessary to initiate and maintain the baseline observing system. The legislation that established NOPP should be reviewed to see if any changes are warranted, but it already provides an appropriate framework to move forward; it may be possible to broaden and strengthen NOPP further by using it as the basis to establish a strong public-private partnership. Consideration should also be given to changing the title of NORLC and Ocean Research Advisory Panel to ensure a necessary longer-term view toward operations, as well as research.

In addition to using the NOPP framework and to foster a commitment by both the Congress and the administration at the outset, consideration should be given to the

issuance of either an executive order or presidential decision directive. Such a document would facilitate coordinated preparation and submission of annual budgets to the administration, promote effective management of the system, support public-private sector and federal-state partnerships, foster development of protocols, and provide a national approach for establishing international relationships. If additional policy coordination is desired, the Ocean Council that was announced recently by the administration could provide additional guidance, but a mechanism will be needed to ensure coordination with the NORLC since the same agencies will be involved in both.

Given the role and interests of various government agencies, the academic research community, the private sector, state governments, and nongovernmental organizations in a national ocean observing system, there is a fundamental need to foster and enhance communication and cooperation by involving all stakeholders in meaningful way. By building on the existing NOPP structure and legislation it will be possible to develop a national ocean observing system public-private partnership organization. In this regard, **the first step should be to establish a multi-sector working group that involves state and local government, academic and industry representatives to foster coordination and integration** (separate from the system users working group mentioned above that will be focused on intersector technical issues). The basic principle of such an organization is that government funding is oriented toward providing a public good or benefit while leveraging and stimulating private-sector investment and capabilities.

FUNDING APPROACH

A variety of federal programs already exist to satisfy mission and research needs which could form the basis for the initial phase in establishing an integrated observing system. These programs were established independently and should continue to serve their intended purposes. Currently, there is no funding for integration or the actions discussed in the investment strategy. In addition, the investment strategy identifies significant new initiatives for observations in coastal regions and the EEZ. Consequently, **additional multi-agency funding should be provided to undertake and accelerate those essential activities required to properly design and implement an integrated observing system.** These additional funds will also ensure broad agency commitment to the integrated system. An overall long-term budget must be developed by the program office, but the program can start with incremental funding of approximately $30 million immediately increasing to about $100 million per year within three to five years as work progresses from the initial phases through concept design to system

development and integration.

The framework established by the NOPP should be used to allocate and coordinate funding decisions. NOPP provides a mechanism to augment ongoing activities and immediately start key near-term initiatives in a phased approach to implementation. The present NOPP funding is insufficient overall, and to date only a few agencies have contributed resources to support NOPP-funded programs. Strengthened federal participation is needed for NOPP to play a sustained role in the development of an integrated ocean observing system.

Financing an integrated national system can be accomplished by providing funds directly to the NOPP program for dedicated, interagency purposes; to individual agencies for specific projects to be carried out by that agency in support of NOPP objectives; and to individual agencies for projects that are primarily aimed at fulfilling an agency's mission but are related to NOPP objectives. These different mechanisms are conceptualized in the diagram in **Figure 2**. The projects under direct control of the NOPP through the NORLC and IWG, or *NOPP-Funded*, form the inner core; the NOPP projects carried out by individual agencies for specific purposes identified through NOPP, or *NOPP-coordinated* funds, form the first annulus; and the projects carried out by individual agencies for projects relevant to NOPP but that are intended to fulfill the agency mission, or *NOPP-related* funds, form the second annulus.

Funding should be allocated to a combination of directed activities and competitively selected, peer reviewed projects, that will allow innovative approaches and new technology developments. In addition, **competitively selected proposals should be used to facilitate the development of a network of tailored, regionally designed systems that would form the basis of a U.S. coastal observing and monitoring network (as described in the Investment Strategy).** Finally, the federal government need not pay for all aspects of the observing system. The system should have co-funding and support from the various sectors that also stand to benefit from it, such as state and private entities. The federal government can provide incentives, set guidelines and standards, establish the EEZ monitoring system, and compete regional systems through NOPP. The federal contribution would also provide for the communication network to which involved organizations can be linked.

RECOMMENDATIONS - ACTION PLAN

Recommendations are made in five areas: A) Management and Organization; B) Funding; C) Investment Strategy; D) Policy; and E) Next Steps. The recommendations are interrelated and represent a multi-pronged approach to

moving forward in a realistic, cost-effective, and focused manner. Taken together they will permit progress to be made as soon as possible and provide accountability to the interests of a broad base of stakeholders. The management of and funding for this system can be achieved in a phased manner, with initial priority given to implementing the open ocean physical component because the technological and scientific framework already exists for this and requires only the funding to move forward.

A. Management and Organization

1. Use NOPP as the basis for establishing the management and organizational structure required to implement a U.S. Ocean Observing System.

2. Develop appropriate interagency memoranda of agreement necessary to ensure defined agency roles and responsibilities.

3. Establish an Integrated System Program Office (ISPO).

4. Establish a National Ocean Observing System Operations Center (NOOSOC).

5. Initiate development of common criteria for program development and implementation.

6. Designate agencies as appropriate for specific functions, such as for the open ocean, coastal/EEZ, and host for the System Program Office and Operations Center.

7. Establish a multi-sector working group under NOPP involving federal, state and local government, academic and private sector representatives to define necessary reciprocal relationships required to implement and sustain the development and operation of a national ocean observing system.

B. Funding

1. Augment current funding with approximately $30 million of new money starting in the first year, and growing to approximately $100 million annually within three to five years. These funds will be used consistent with an implementation plan to be approved by the National Ocean Research Leadership Council. It should be noted that this report does not include a detailed budget breakdown, but rather has a conservative overall estimate of funding required for a concerted effort to achieve an integrated ocean

observing system. The funds should be allocated to the operational areas indicated in the investment strategy, which constitute the necessary elements of the initial phase of the system development and implementation.

2. Funds should be allocated to individual agencies with the purpose clearly identified for NOPP related ocean observing system in accordance with an overall plan to be developed within the NOPP management framework.

3. Examine on-going activities to ensure there are currently no redundancies of effort and to further identify gaps requiring additional funding.

C. Investment Strategy

These represent the first steps that can be taken with respect to the actual observations, data management and communications. They include a number of integration efforts, enhancements to existing programs, and new projects; the latter two will require new funding while the former will involve reorganization, streamlining, and elimination of redundant activities.

1. System Design and Engineering Analysis

    - Use an end-to-end systems engineering and development approach with a systems integrator to develop a schedule and plan that ranges from concept design to operational implementation where appropriate.
    - Conduct a system engineering analysis to determine how current and planned systems can be more cost-effectively integrated in the near term.

2. Enhancements of Existing Operational Systems

    Detailed recommendations for improvements or changes in observing programs are described in detail in the various reports. In the near term it is most important to:

    - Fund projects to enhance current operational or research networks that demonstrate an integrated approach to ocean observations or demonstrate a multi-systems approach that is practical and scaleable to larger systems. Examples of specific actions that should be considered that would result in core components of an ocean observing system are listed below.
        - Transition from research to operations the combination of satellite altimetric and in situ observations that would

characterize the state of the ocean by accelerating deployment of a global array of profiling floats and ensuring the continuity of existing measurement programs in satellite altimetry, acoustic thermometry, and fixed sensor arrays.

- Improve the quality and increase the quantity of surface marine meteorological and physical oceanographic observations.
- Develop a network of coastal surface radar stations for determining surface currents and surface wave fields.

3. Concept Demonstration Projects

- Competitively fund projects to develop regional observing systems at a rate of 2-3 per year for five years each. As these regional systems prove their capabilities, the next phase will be to transition them into the overall system with some base level of sustained federal support.
- Fund a project to develop an observing system in the U.S. exclusive economic zone (EEZ). The EEZ portion of the system, since it will be maintained by federal agencies, will have to follow a slightly different track from the regional subsystems described above. It will likely be initiated along all coasts simultaneously and will eventually transition into the overall system in close coordination with the regional subsystems.
- Coordinate the development of seafloor observing systems through Dynamics of Earth and Ocean Systems (DEOS) by funding the program initiated by NSF and by ensuring its transition to operational capability by making it part of the overall IOOS.

Additional concept demonstration projects are recommended as part of the Data management section. below.

4. Data Management, Dissemination, and Assimilation

- Convene the Standards and Protocols Working Group to develop an overall architecture for the system that incorporates existing data centers as well as specific standards/protocols for data coming into the that system.
- Implement a national effort to share data from multiple coastal data systems.

- Carry out the U.S. component of the Global Ocean Data Assimilation Experiment (GODAE), a multi-year global pilot project to assimilate in situ and satellite physical data.
- Fund the development of prototype national data systems based on existing ones and at least one project to develop a regional "test-bed" system that interfaces with existing National Data Centers, the latter in conjunction with one of the regional demonstration projects as appropriate.

5. New Technology

- Develop appropriate techniques for remote sensing and in situ biological measurements, and incorporate them into a sustained, distributed infrastructure such as satellites, in situ floats, cables, and buoys.
- Develop techniques for making observations of carbon dioxide and chemical and isotopic tracers, and incorporate them into a sustained, distributed infrastructure such as satellites and in situ floats.

D. Policy

1. Review NOPP legislation and make appropriate changes to ensure a balance between research and operations.

2. Encourage the administration to prepare an executive order or presidential decision directive that advances the national goal for a sustained ocean observing system, promotes effective interagency management, and provides a national approach for establishing international relationships.

3. Develop legislation as appropriate to establish a public-private partnership that provides the framework for private sector and state and local government participation, and for contributions to the system.

4. Develop a management policy, open system architecture, and standards and protocols for inclusion in the system.

E. Next Steps

1. Initiate actions as soon as possible under the auspices of the National Ocean Research Leadership Council of NOPP to begin the process of implementation.

2. Initiate outreach activities with state and local governments, academia, non-governmental organizations, and industry to solicit support, involvement, and contributions for system design and governance.

3. Work with existing international organizations to establish connectivity with appropriate international observing systems.

CONCLUSIONS

There are no technical or legislative impediments to implementing a National Ocean Observing System. Existing programs and a policy framework are already in place to get started. Appropriate modifications to policy, relatively modest increases in funding, and implementation of a management structure are essential but the nation's oceanographic community is prepared to move forward. Development and integration of the IOOS will not be easy, but by building on the current infrastructure and demonstrating a national commitment, an ocean observing system can become a reality. With a realistic investment ***a National Ocean Observing System that does not exist today can be built within ten years.*** The nation will realize the economic and environmental benefits of taking a new approach to realizing the potential of the global ocean.

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Appendix I

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Appendix II

Subtitle E--National Oceanographic Partnership Program

SEC. 281. FINDINGS.

Congress finds the following:

(1) The oceans and coastal areas of the United States are among the Nation's most valuable natural resources, making substantial contributions to economic growth, quality of life, and national security.

(2) Oceans drive global and regional climate. Hence, they contain information affecting agriculture, fishing, and the prediction of severe weather.

(3) Understanding of the oceans through basic and applied research is essential for using the oceans wisely and protecting their limited resources. Therefore, the United States should maintain its world leadership in oceanography as one key to its competitive future.

(4) Ocean research and education activities take place within Federal agencies, academic institutions, and industry. These entities often have similar requirements for research facilities, data, and other resources (such

as oceanographic research vessels).

(5) The need exists for a formal mechanism to coordinate existing partnerships and establish new partnerships for the sharing of resources, intellectual talent, and facilities in the ocean sciences and education, so that optimal use can be made of this most important natural resource for the well-being of all Americans.

SEC. 282. NATIONAL OCEANOGRAPHIC PARTNERSHIP PROGRAM.

(a) PROGRAM REQUIRED.--(1) Subtitle C of title 10, United State Code, is amended by adding after chapter 663 the following new chapter:

"CHAPTER 665--NATIONAL OCEANOGRAPHIC PARTNERSHIP PROGRAM

"Sec.

"7901. National Oceanographic Partnership Program.

"7902. National Ocean Research Leadership Council.

"7903. Ocean Research Advisory Panel.

"Sec. 7901. National Oceanographic Partnership Program

"(a) ESTABLISHMENT.--The Secretary of the Navy shall establish a program to be known as the 'National Oceanographic Partnership Program'.

"(b) PURPOSES.--The purposes of the program are as follows:

"(1) To promote the national goals of assuring national security, advancing economic development, protecting quality of life, and strengthening science education and communication through improved knowledge of the ocean.

"(2) To coordinate and strengthen oceanographic efforts in support of those goals by--

"(A) identifying and carrying out partnerships among Federal agencies, academia, industry, and other members of the oceanographic scientific community in the areas of data, resources, education, and communication; and

"(B) reporting annually to Congress on the program.

"Sec. 7902. National Ocean Research Leadership Council

"(a) COUNCIL.--There is a National Ocean Research Leadership Council (hereinafter in this chapter referred to as the 'Council').

"(b) MEMBERSHIP.--The Council is composed of the following members:

"(1) The Secretary of the Navy.

"(2) The Administrator of the National Oceanic and Atmospheric Administration.

"(3) The Director of the National Science Foundation.

"(4) The Administrator of the National Aeronautics and Space Administration.

"(5) The Deputy Secretary of Energy.

"(6) The Administrator of the Environmental Protection Agency.

"(7) The Commandant of the Coast Guard.

"(8) The Director of the Geological Survey of the Department of the Interior.

"(9) The Director of the Defense Advanced Research Projects Agency.

"(10) The Director of the Minerals Management Service of the Department of the Interior.

"(11) The Director of the Office of Science and Technology.

"(12) The Director of the Office of Management and Budget.

"(c) CHAIRMAN AND VICE CHAIRMAN.--(1) Except as provided in paragraph (2), the chairman and vice chairman of the Council shall be appointed every two years by a selection committee of the Council composed of, at a minimum, the Secretary of the Navy, the Administrator of the National Oceanic and Atmospheric Administration, and the Director of the National Science Foundation. The term of office of the chairman and vice chairman shall be two years. A person who has previously served as chairman or vice chairman may be reappointed.

"(2) The first chairman of the Council shall be the Secretary of the Navy. The first vice chairman of the Council shall by the Administrator of the National Oceanic and Atmospheric Administration.

"(d) RESPONSIBILITIES.-- The Council shall have the following responsibilities:

"(1) To prescribe policies and procedures to implement the National Oceanographic Partnership Program.

"(2) To review, select, and identify and allocate funds for partnership projects or implementation under the program, based on the following criteria:

"(A) Whether the project addresses critical research objectives or operational goals, such as data accessibility and quality assurance, sharing of resources, education, or communication.

"(B) Whether the project has broad participation within the oceanographic community.

"(C) Whether the partners have a long-term commitment to the objectives of the project.

"(D) Whether the resources supporting the project are shared among the partners.

"(E) Whether the project has been subjected to adequate peer review.

"(3) To assess whether there is a need for facility (of facilities) to provide national centralization of oceanographic data, and to establish such a facility of facilities if determined necessary. In conducting the assessment, the Council shall review, at a minimum, the following:

"(A) The need for a national oceanographic data center.

"(B) The need for a national coastal data center

"(C) Accessibility by potential users of such centers.

"(D) Preexisting facilities and expertise.

"(e) ANNUAL REPORT.-- Not later than March 1 of each year, the Council shall submit to Congress a report on the National Oceanographic Partnership Program. The report shall contain the following:

"(1) A description of activities of the program carried out during the fiscal year before the fiscal year in which the report is prepared, together with a list of the members of the Ocean Research Advisory Panel and any working groups in existence during the fiscal year covered.

"(2) A general outline of the activities planned for the program during the fiscal year in which the report is prepared.

"(3) A summary of projects continued from the fiscal year before the fiscal year in which the report is prepared and projects expected to be started during the fiscal year in which the report is prepared and during the following fiscal year.

"(4) A description of the involvement of the program with Federal interagency coordinating entities.

"(5) The amounts requested, in the budget submitted to Congress pursuant to section 1105(a) of title 31 for the fiscal year following the fiscal year in which the report is prepared, for the programs, projects, and activities of the program and the estimated expenditures under such programs, projects, and activities during such following fiscal year.

"(f) PARTNERSHIP PROGRAM OFFICE.--(1) The Council shall establish a partnership program office for the National Oceanographic Partnership Program. The Council shall use competitive procedures in selecting an operator for the partnership program office.

"(2) The Council shall assign the following duties to the partnership program office:

"(A) To establish and oversee working groups to propose partnership projects to the Council and advise the Council on such projects.

"(B) To manage the process for proposing partnership projects to the Council, including managing peer review of such projects.

"(C) To submit to the Council an annual report on the status of all partnership projects and activities of the office.

"(D) Any additional duties for the administration of the National Oceanographic Partnership Program that the Council considers appropriate.

"(3) The Council shall supervise the performance of duties by the partnership program office.

"(g) CONTRACT AND GRANT AUTHORITY.-- The Council may authorize one or more of the departments or agencies represented on the Council to enter into contracts and make grants, using funds appropriated pursuant to an authorization for the National Oceanographic Partnership Program, for the purpose of implementing the program and carrying out the responsibilities of the Council.

"(h) ESTABLISHMENT AND FORMS OF PARTNERSHIP PROJECTS.--(1) A partnership project under the National Oceanographic Partnership Program may be established by any instrument that the Council considers appropriate, including memoranda of understanding, a cooperative research and development agreements, and similar instrument.

"(2) Projects under the program may include demonstration projects.

"Sec. 7903. Ocean Research Advisory Panel

‘‘(a) Establishment.--The Council shall establish an Ocean Research Advisory Panel consisting of not less than 10 and not more than 18 members appointed by the chairman, including the following:

‘‘(1) One member who will represent the National Academy of Sciences.

‘‘(2) One member who will represent the National Academy of Engineering

‘‘(3) One member who will represent the Institute of Medicine.

‘‘(4) Members selected from among individuals who will represent the views of ocean industries, State governments, academia, and such other views as the chairman considers appropriate.

‘‘(5) Members selected from among individuals eminent in the fields of marine science or marine policy, or related fields.

‘‘(b) Responsibilities.--The Council shall assign the following responsibilities to the Advisory Panel:

‘‘(1) To advise the Council on policies and procedures to implement the National Oceanographic Partnership Program.

‘‘(2) To advise the Council on selection of partnership projects and allocation of funds for partnership projects for implementation under the program.

‘‘(3) To advise the Council on matters relating to national oceanographic data requirements.

‘‘(4) Any additional responsibilities that the Council considers appropriate.

‘‘(c) Funding.--The Secretary of the Navy annually shall make funds available to support the activities of the Advisory Panel.’’.

(2) The table of chapters at the beginning of subtitle C of title 10, United States Code, and at the beginning of part IV of such subtitle, are each amended by inserting after the item relating to chapter 663 the following:

"665. National Oceanographic Partnership Program.....7901".

(b) INITIAL APPOINTMENTS OF ADVISORY PANEL MEMBERS.--The National Ocean Research Leadership Council established by section 7902 of title

10, United States Code, as added by subsection (a)(1), shall make the appointments required by section 7904 of such title not later than January 1, 1998.

(c) FIRST ANNUAL REPORT OF NATIONAL OCEAN RESEARCH LEADERSHIP COUNCIL.--The first annual report required by section 7902(f) of title 10, United States Code, as added by subsection (a)(1), shall be submitted to Congress not later than March 1, 1997. The first report shall include, in addition to the information required by such section, information about the terms of office, procedures, and responsibilities of the Ocean Research Advisory Panel established by the Council.

(d) AUTHORIZATION OF APPROPRIATIONS.--(1) Of the amount authorized to the Department of the Navy by section 201(2), $13,000,000 shall be available for the National Oceanographic Partnership Program established pursuant to section 7901 of title 10, United States Code, as added by subsection (a)(1).

(2) Of the amount authorized to be appropriated to the Department of the Navy by section 301(2), $7,500,000 shall be available for such program.

(e) FUNDING FOR PROGRAM OFFICE - Of the amount appropriated for the National Oceanographic Partnership Program for fiscal year 1997, at least $500,000, or 3 percent of the amount appropriated, whichever is greater, shall be available for operations of the partnership program office established pursuant to section 7903(g) of title 10, United States Code as added by subsection (a)(1), for such fiscal year.
